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22 August 1955

CMCC Doc. No. 151.676
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Dear Dick:

We are forwarding herewith five copies of the Monthly Progress Report No. 3 which covers the work performed on System No. 3 for the period extending from 4 July 1955 to 4 August 1955. The report is otherwise identified by CMCC Doc. No. 163.2009.

Progress on this system seems to be excellent, and the work is presently on schedule.

Sincerely,

Burt

Burt

Enclosure:
CMCC Doc. No. 163.2009
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Monthly Progress Report No. 3

System No. 3

Contract No. A-101

4 July 1955 to 4 August 1955

CMCC Document No. 163.2009

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1-0. INTRODUCTION.

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[redacted] The detailed design requirements, as well as an outline of the proposed design which meets these requirements, appears in the Technical Exhibit of the System No. 3 Proposal.

1-2. Prior to the present report period, the basic system design had been completed and the design and construction of the system components had begun. Progress in the basic design and construction of the system components are described in previous monthly letter reports. During the present report period, work has continued on the detailed design and construction of the components comprising the first breadboard model of the system.

2-0. SYSTEM COMPONENTS.

2-1. ANTENNA. A 20:1 scale model of the airplane with antenna mounted in place has been fabricated for use in making pattern measurements. Final modifications and adjustments of the pattern measuring equipment are presently being made and antenna measurements using this equipment are about to begin. Drawings have been started on a 2:1 scale model of the nose section of the airplane for use in making impedance measurements. This model will consist of a wooden framework covered with a skin of copper screen.

2-2. R-F ASSEMBLY. A new chassis for the first breadboard unit is being built. The artificial line which forms the distribution network connecting the preamplifier to the nine r-f heads has been installed. The sections of the line are joined by a plug-in construction and the line has been checked under simulated operating conditions. Initially, considerable fluctuations were present in the frequency responses, but these have been removed and the line has less than a 2 db variation in

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amplitude over [redacted] A preliminary version of the preamplifier which is to be placed between the antenna and the distribution network has been built. The G. E. Type 6299 Planar triode, which is being used, has a physical form best suited for use in a grounded grid circuit. Due to the impedance transformation required in the intended application, however, a special mounting has been designed and this tube is being used in a grounded cathode circuit. The tests made thus far show a gain of about eight db with a bandwidth of 70 mc. The circuit used has proved to be stable without neutralization. The input transformer of the amplifier has been designed to match the 50-ohm antenna impedance to the optimum impedance for minimum noise figure. Considerable effort has been expended in the continuation of the study of the image and spurious response problem. The result has been the in-

corporation of a triple-tuned circuit between the r-f amplifier and mixer which contributes about 50 db of image rejection. Additional image rejection is to be obtained by the use of a filter in the pre-amplifier section. This will consist of an M-derived T-section, one or two sections of constant-K filters, and a shunt M-derived half-section filter, all presently being designed. To avoid frequency doubling in the first local oscillator, consideration is being given to the use of a crystal oscillator whose fundamental frequency is the frequency desired. This would eliminate the possibility of generating undesired frequencies, due to beating of the oscillator fundamental and spurious input signals. However, circuits capable of generating a fundamental at the frequency desired require the use of VHF crystals operated at the seventh or ninth mechanical overtone.

2-3. I-F ASSEMBLY. The i-f assembly, presently being constructed by the RS Electronics Corporation, was originally scheduled to be completed on July 22. Although the basic design of the i-f assembly was completed and tested on this due date, the bandwidth of the second i-f amplifier was too broad, a means of measuring the first mixer crystal current had to be added, the tendency toward self oscillation had to be eliminated, and more complete test data had to be obtained. For these reasons, delivery of the i-f assembly has been rescheduled for August 16.

2-4. SECOND LOCAL-OSCILLATOR ASSEMBLY. The multi-frequency crystal controlled oscillator has been tested in preliminary form and appears to meet all requirements. Redesign and construction of the final chassis for the first breadboard unit is underway and construction will be completed when crystals are received from the manufacturer about August 12. The design of the electronic commutator which performs the switching of the oscillator is largely completed and closely approximates the final form. This design has returned to the use of transistors in the scale-of-16 counter. Originally, difficulty was experienced because of the lack of uniformity in the characteristics of the different transistors of a given type, but this has been overcome in the present circuit. A vacuum-tube buffer amplifier is being used to connect the counter to the diode switching matrix. The result provides a plus 60-volt bias for the "on" condition of the crystal diode gates and a minus 40-volts bias for the "off" condition. This represents a considerable margin of safety over the minimum operating conditions. The matrix which originally employed 64 diodes now uses 48. A drawing of the printed circuit board required for the matrix has been completed and bids are being received for its fabrication. The commutator section which performs the gating of the r-f heads has also been built in its preliminary form. Gating of r-f heads is performed by biasing an r-f head beyond cut-off for the "off" condition and returning the normal bias during the "on" condition. Initially, difficulty was experienced in getting a consistent bias for the "on" condition, particularly with varying plate voltage and trigger amplitudes, but this has been improved by reversing the sign of the triggering pulse and reducing the plate current demands on the gating circuit. The present design will accommodate a ±30% change in plate

supply voltage and a ± 50% change in trigger amplitude. This section of the commutator has been packaged in final form for the first breadboard unit but cannot be finished until all parts have been received about August 10.

2-5. THIRD LOCAL-OSCILLATOR ASSEMBLY. Improvements have been made on the sweep circuit which controls the frequency of the third local oscillator. The method used to measure and record the third local oscillator frequency when it is locked on a signal is to measure the time between the start of a sweep and the instant of lock-on. Thus, it is required that the sweep always start from the same point in the cycle, and that the sweep capacitor discharge completely. To accomplish this, a triode driver has been added to the circuit to increase the rate of discharge of the sweep capacitor by providing a low-impedance discharge path. In addition, this triode aids in reducing the leakage current of the capacitor during the signal lock-on interval. Another addition to the circuit has been a means of generating a reference pulse at the beginning of each complete scan cycle. This reference pulse will have 1/2 the width of the normal pulses. A count of these pulses yields frequency information. A new chassis is being constructed and wired to include these changes and should be completed upon delivery of the special low-leakage isolation transformer which is due to arrive about August 8.

2-6. PLAYBACK UNIT. The study of the playback system is continuing with several alternative methods under consideration. In connection with this study, tests have been conducted on the effects of re-recording with magnetic tape on voice and pulse recording quality. These tests indicate pulse quality deterioration is high for re-recordings and that it is essential that the information contained in the pulses be obtained from the original tape. Meanwhile, the development of the components which are common to all of the possible methods has begun. The experimental form of most of the circuits in the pulse separator have been completed. The pulse separator performs the initial step in the conversion of the coded frequency and time information on the magnetic tape by separating code pulses, timing tones, and audio messages. A playback preamplifier consisting of a negative feedback amplifier, a skimmer, which separates the pulses from the recorded messages, a pulse regenerator, and a number of other pulse-handling circuits are included. These circuits provide a train of pulses whose count indicates frequency to the nearest 350 kc, a second train of pulses whose spacing relative to the first train indicates frequency to the nearest 25 kc, and a pulse of audio frequency to signal half-hour recording periods. These circuits are also required to separate the monitored audio signal from the pulse trains and half-hour audio signal indicated above.

2-7. TEST UNIT. The audio amplifier which is used to monitor the airborne recorder and receiver unit has been built and performs satisfactorily. Construction of the final layout of the r-f test oscillator has been started and the lowest and highest frequency channels have been tested and found to work satisfactorily.

3-0. SUMMARY. Experimental work is in progress on all circuits of the system. With the exception of the playback unit, the final circuit design of all system components has been tentatively established. Construction of subassemblies for the first breadboard model is in progress and it is expected that preliminary testing of the airborne receiver unit will begin during the next report period.